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**Methods:** This is a retrospective study conducted by reviewing the screening records of school-based ear health programs conducted by our institute over a five-year period. Medical records of children diagnosed with chronic otitis media were studied and segregated. Data including diagnoses, tympanic membrane findings and pure tone audiogram reports were documented and analyzed.

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# Chronic Otitis Media and Hearing Loss in Nepalese Schoolchildren

Milan Maharjan <sup>α</sup>, Rosy Bajracharya <sup>σ</sup> & Elina Maharjan <sup>ρ</sup>

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**Results:** The medical screening records of 79,340 children were studied. Chronic otitis media was seen in 8.04% (n=6382) of children, of which 78.94% (n=5038) were found to be unilateral, and 21.06% (n=1344) with bilateral ears diagnosed. Of the children with chronic otitis media, 41.57% (n=2653) had hearing a loss of 25dB or greater. Hearing loss was conductive in 93.40% (n=2478) of these cases and mixed loss was found to be in 6.6% (n=175) of these. The degree of hearing loss increased with the increasing age of the children.

**Conclusions:** Chronic otitis media in children is a public health issue in Nepal. This needs to be addressed urgently to reduce disease burden. Early management of chronic otitis media can prevent hearing loss caused by chronic ear infections in Nepalese children.

**Keywords:** chronic otitis media, hearing loss, schoolchildren, nepal.

## I. INTRODUCTION

Chronic Otitis media (COM) is a permanent abnormality of the pars tensa or pars flaccida, most likely a result of previous acute otitis media, otitis media with effusion or long-standing negative middle ear pressure.<sup>1</sup> The prevalence of chronic otitis media has been reported to be between less than 1% in high-income countries to up to 46% in disadvantaged ethnic groups and low-income countries.<sup>2</sup> A prevalence of 1-2% of COM in children in a definite community is considered low and a prevalence of more than 4% is considered high, which also indicates a public health issue requiring urgent attention.<sup>3</sup>

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Chronic otitis media is the leading cause of preventable hearing loss in children, especially in developing countries. According to the WHO, about 60% of people with COM have clinically significant hearing loss and 90% of these are in developing countries.<sup>3</sup> This is a matter of serious concern especially in children because of the negative developmental and educational impacts caused by hearing loss. Chronic otitis media contributes most to the global burden of hearing loss; hence, eliminating it can potentially reduce the global burden of hearing loss.

Recent prevalence of chronic otitis media in Nepalese children is not known, and there is lack of accurate data. The little available data are from either hospital-based or of small cohort studies. More recent data on COM prevalence would help to determine if COM management should be prioritized in the national health care program. Therefore, the main objective of our study is to find out the most recent status of chronic otitis media in Nepalese children and to evaluate corresponding hearing loss.

## II. METHODS

This is a retrospective study based on data from the medical records of Nepalese Schoolchildren who participated in the school-based ear health programs conducted by our institute over a five-year period from January 2015 through January 2020. Permission to conduct the school-based ear health programs was obtained in writing from the educational authorities of the concerned district and from the individual schools. Schools that provided written consent to conduct ear health program were included in the study. The schools that did not consent were excluded.

The medical records contain otoscopic findings of the tympanic membrane, final diagnoses and pure tone audiometry reports of all the children. Detail findings of the tympanic membrane such as the integrity of the membrane, the size and site of perforations, the presence of ear discharge and cholesteatoma were recorded. Demographic details such as age, gender, grade, and ethnicity were also documented. All the confirmed cases of chronic otitis media in children in grades 1 through 10 along with their pure tone audiometry reports were included in the study. Children diagnosed with acute otitis media, otitis media with effusion, ear diseases other than COM and children with normal findings were excluded from this study. Children

with incomplete medical records or missing data were also not included in this study.

The school-based ear screening programs were conducted and documented by senior Ear Nose Throat surgeons having more than five years experiences in this community screening work. A Heine Mini 3000 otoscope was used for tympanic membrane examinations. Chronic otitis media was diagnosed when there was a permanent abnormality of the pars tensa or pars flaccida with or without active ear discharge. It is divided into chronic otitis media mucosal and chronic otitis media squamous as per Browning et al. classification of COM.<sup>4</sup>

Pure tone audiometry was conducted and documented by an audio-technician using an Arphi Proton SX3 pure tone audiometer. Hearing loss was defined as a pure tone average of four frequencies 0.5, 1, 2, and 4kHz greater than 25dB HL in one or both ears. Data analysis was done using frequency and percentage. The ethical clearance to conduct the study was approved by the Nepal Health Research Council (NHRC) bearing registration number 345/2021 P.

### III. RESULTS

Over a period of five years from January 2015 until January 2020, 79,340 children from grades 1 through grade 10 were screened for ear and hearing problems. Out of which, chronic otitis media was diagnosed in 8.04% (n=6,382) children, of which 50.75% (n=3,239) were in boys and 49.25% (n=3,143) in girls. Ages of the children in the study ranged between 4 to 18 years old. The majority of the children with chronic otitis media 60.59% (n=3,867) were aged 11-15 years old with only 3.85% (n=246) of children in the 4 to 5 years age group testing positive for this. Chronic otitis media was seen in 41.84% (n=2,670) of right ears, in 37.10% (n=2,368) of left ears and bilaterally in 21.06% (n=1,344) of the children. Mucosal-COM was seen in 30.68% (n=1,958), and squamous-COM in 6.80% (n=434) children. Different types of COM by age group are shown in Table 1.

Table 1: Age distribution of children with different types of chronic otitis media

| Age distribution | Children with chronic otitis media n (%) | Types of chronic otitis media n (%) |               |
|------------------|------------------------------------------|-------------------------------------|---------------|
|                  |                                          |                                     |               |
| <5 years old     | 246 (3.85%)                              | Mucosal                             | 239 (97.15%)  |
|                  |                                          | Squamous                            | 7 (2.84%)     |
| 5-10 years old   | 1,220 (19.12%)                           | Mucosal                             | 1135 (93.03%) |
|                  |                                          | Squamous                            | 85 (6.97%)    |
| 11-15 years old  | 3,867 (60.59%)                           | Mucosal                             | 3580 (92.58%) |
|                  |                                          | Squamous                            | 287 (7.42%)   |
| >15 years old    | 1,049 (16.44%)                           | Mucosal                             | 994 (94.76%)  |
|                  |                                          | Squamous Active                     | 55 (5.24%)    |
| Total            |                                          | 6,382                               |               |

Hearing loss was seen in 41.57% (n=2,653) of the children with chronic otitis media, out of which 93.40% (n=2,478) of the cases were conductive hearing loss, which was of mild degree in 87.36% (n=2,165), moderate in 9.76% (n=242) and moderately severe in 2.86% (n=71) of the children. Mild conductive hearing loss was the commonest type of hearing loss. This was seen in 81.60% (n=2,165) of the children with COM,

whereas, moderately severe mixed hearing loss was the least commonly seen in only 1.31% (n=35) of children with chronic otitis media. 95.60% of children with mucosal-COM had associated hearing loss, whereas only 74.65% of children with squamous-COM had hearing loss. The type and degree of hearing loss associated with different types of COM by age groups are shown in Table 2.

Table 2: Chronic otitis media with type and degree of hearing loss

| Age distribution | Children with chronic otitis media n (%) | Children with hearing loss n (%) | Type and degree of hearing loss n (%) |                   |                |
|------------------|------------------------------------------|----------------------------------|---------------------------------------|-------------------|----------------|
|                  |                                          |                                  |                                       |                   |                |
| <5 years old     | 246 (3.85%)                              | 14 (5.69%)                       | Conductive hearing loss               | Mild              | 13 (92.86%)    |
|                  |                                          |                                  |                                       | Moderate          | 1 (7.14%)      |
| 5-10 years old   | 1,220 (19.12%)                           | 438 (35.90%)                     | Conductive hearing loss               | Mild              | 372 (84.93%)   |
|                  |                                          |                                  |                                       | Moderate          | 28 (6.40%)     |
|                  |                                          |                                  |                                       | Moderately Severe | 11 (2.51%)     |
|                  |                                          |                                  | Mixed hearing loss                    | Moderate          | 10 (2.28%)     |
|                  |                                          |                                  |                                       | Moderately Severe | 9 (2.05%)      |
|                  | Severe                                   | 8 (1.82%)                        |                                       |                   |                |
| 11-15 years old  | 3,867 (60.59%)                           | 1,603                            | Conductive                            | Mild              | 1,372 (85.59%) |

|               |                |                |                         |                   |              |
|---------------|----------------|----------------|-------------------------|-------------------|--------------|
|               |                | (41.45%)       | hearing loss            | Moderate          | 101 (6.30%)  |
|               |                |                |                         | Moderately severe | 42 (2.62%)   |
|               |                |                | Mixed hearing loss      | Moderate          | 48 (3%)      |
|               |                |                |                         | Moderately severe | 21 (1.31%)   |
|               |                |                |                         | Severe            | 19 (1.18%)   |
| >15 years old | 1,049 (16.44%) | 598 (57.01%)   | Conductive hearing loss | Mild              | 408 (68.22%) |
|               |                |                |                         | Moderate          | 112 (18.73%) |
|               |                |                |                         | Moderately severe | 18 (3.01%)   |
|               |                |                | Mixed hearing loss      | Moderate          | 29 (4.85%)   |
|               |                |                |                         | Moderately severe | 5 (0.83%)    |
|               |                |                |                         | Severe            | 26 (4.35%)   |
| Total         | 6,382          | 2,653 (41.57%) |                         |                   |              |

#### IV. DISCUSSIONS

Despite improvement in public health care in last two decades, there is still a significant burden of chronic otitis media in school-aged children in Nepal. This study shows that the prevalence of chronic otitis media in Nepalese schoolchildren is 8.04%. According to WHO categorization of the countries with disease burden, a prevalence rate of 8.04% places Nepal in the group of the countries with the highest prevalence rates. The high prevalence rate in our study may be caused by increased exposure of the study children to risk factors associated with low socioeconomic strata such as overcrowding, passive smoke and poor nutrition.

The largest population-based survey was conducted in 1991 in the general population and found that 7.4% of all Nepalese had middle ear pathology.<sup>5</sup> Following that, a few studies conducted in small pediatric populations have reported prevalence rates of 3.26% by Thakur et al.<sup>6</sup> 5% by Adhikari et al.<sup>7</sup> and 10% by Maharjan et al.<sup>8</sup> The relatively low prevalence rate reported by Thakur et al. could be due to differences in sampling size and sampling technique followed in the study. Adhikari et al. conducted the study in urban private schools where socioeconomic status and literacy rates of the parents are high, which could explain the lower number of children with COM in their study group. The school where Maharjan et al. conducted their study mostly enrolled children from one particular ethnic group with poor socioeconomic backgrounds where children had the habit of swimming in dirty water along with their cattle during hot and humid weather in the plains of Nepal, which must have acted as a predisposing factor for chronic discharging ear. Swimming in local pools has been considered an associated risk factor in developing COM.<sup>9</sup> In comparison, the prevalence of COM in children has been reported as 4.79% in India,<sup>10</sup> 5.2% in Bangladesh,<sup>11</sup> 7.26% in Malaysia,<sup>12</sup> 1.74% in Thailand,<sup>13</sup> 2.19% in Korea<sup>14</sup> and 1.65% in Indonesia.<sup>15</sup>

In the African countries, lower prevalence rates of COM have been reported such as 4% in Rwanda,<sup>16</sup> 5.3% in Malawi,<sup>17</sup> 1.4% in Tanzania,<sup>18</sup> and 1.5% in Kenya.<sup>19</sup> Low prevalence rates have been reported in other parts of the globe as well, such as 1.31% in Saudi

Arabia<sup>20</sup> and, 0.94% in Brazil.<sup>21</sup> Developed nations such as the US, the UK and most of the European countries have prevalence rates of less than 1%.<sup>3</sup> Contrary to this, high prevalence rates of COM are reported in certain populations and ethnic minorities<sup>22</sup> such as Australian Aborigines,<sup>23</sup> the Inuit<sup>24</sup> and Greenlandic children.<sup>25,26</sup> The wide range in the prevalence rates in these epidemiological studies could be due to differences in exposure to risk factors and access to health care among the study population, population size, ethnic group, sampling technique, and methodology. Differences in the definition and classification of COM used in the study is another important factor for wide variations in the prevalence rates. In our study, the Browning classification of COM was followed because it is the classification of choice used in Nepal. Classifications such as suppurative and non-suppurative COM are now less commonly used because it is the progression of the same pathological process. Similarly, use of tubo-tympanic as safe and attico-antral as unsafe COM is not recommended any longer since marginal perforations of the pars tensa can also develop complications.<sup>27</sup> Many studies classified COM as tubo-tympanic and attico-antral.<sup>7,28,29</sup> Muftah et al.<sup>9</sup> and Hunt et al.<sup>17</sup> only included the cases with active ear discharge lasting more than 2 weeks with perforated tympanic membrane and excluded the cases with dry perforation and healed tympanic membrane in their study. Other factors such as genetic and environmental factors as a possible cause need to be further studied in certain populations and ethnic minorities.

We did not find gender preponderance in our study; COM was almost equal in both boys and girls, which is consistent with other studies.<sup>16,30</sup> Several studies found that older children were more likely to develop COM than the younger children were.<sup>9, 17, 30</sup> We too found that 60.59% of the COM cases were seen in older children aged 11-15 years and least affected were the youngest children aged five years and younger at 3.85%. COM as well as sequelae of COM such as tympanosclerosis and atelectasis climbed steadily with increasing age suggesting chronicity of the disease.<sup>19</sup> The high prevalence of COM in older children could be result of frequent and untreated or poorly treated cases

of acute otitis media and/or otitis media with effusion, which progressed into the chronic phase of the disease. Additionally, traditional practices such as instillation of oil or other liquids to treat ear diseases can lead to continuous otorrhoea progressing the disease into the chronic phase. This trend could explain increasing rates of COM in older children.

Chronic otitis media was unilateral in 78.94% (n=5,038) and bilateral in 21.06% (n=1,344) children. This finding is consistent with other studies.<sup>7, 16, 19, 28,31</sup> Bilateral disease are thought to have poor consequence because of associated bilateral hearing loss and poorer surgical outcome. Eustachian tube dysfunction is considered as the main pathogenesis of bilateral disease whereas, in unilateral cases, more localized causes are assumed. Many studies suggest an increased risk of developing COM in the contralateral ear in later years but to evaluate the status of the contralateral ear, a long-term follow up of the children with unilateral disease would be needed.<sup>32, 33</sup>

In this study, out of 6,382 cases, mucosal-COM was the most commonly observed COM, detected in 30.68% (n=1,958) of the children and the squamous type detected in only 6.80% (n=434). Similar findings were also noted in other studies.<sup>7,10,28,29,31</sup> Contrary to our findings, squamous-COM was more commonly seen in a study conducted by Kumari et al.<sup>34</sup> whereas; Abraham et al.<sup>18</sup> did not find a single case of squamous-COM in their study. Simoes et al.<sup>19</sup> detected squamous-COM in only 0.45% cases whereas 62.51% (n=3,990) of the children had scarring of the tympanic membrane such seen as a thin and healed tympanic membrane, tympanosclerosis, and chalk white patches suggesting previous history of otitis media.

A literature review on childhood hearing loss published by Davidson et al. found that children from developing countries had almost double the chances of developing associated hearing loss in COM than in children from developed countries. In our study, we found that 41.57% (n=2,653) of the children with COM were suffering from hearing loss. Similarly, other studies conducted in developing countries also reported increase possibilities of developing hearing loss due to COM.<sup>9, 31, 34, 35</sup>

The hearing loss in this study was predominantly the conductive type 93.40% (n=2478) and of a mild degree 87.36% (n=2165). Muftah et al. also observed a similar pattern<sup>9</sup> whereas Anggraeni et al. stated that most of the hearing loss associated with COM in their study group was of a moderate degree.<sup>35</sup> In our study mixed hearing loss suggesting involvement of the inner ear was seen in 6.60% (n=175) of children with COM. This finding demonstrates that the inner ear is vulnerable to chronic discharging ears.<sup>36-40</sup> Significant involvement of bone conduction thresholds were noted in cases with COM.<sup>41-44</sup> In this study we observed that hearing loss in children with COM increased steadily

with increasing age, from 5.69% in <5 year old's to 57.01% in children >15 years old. Sakagami et al. found hearing deterioration was more in the ear with COM than in the normal ear; 0.61dB/year versus 0.13 dB/year.<sup>45</sup> Long-term follow up of COM and its impact on the bone conduction found significant association between duration of COM and presence of involvement of bone conduction.<sup>41,44</sup>

It was observed that in mucosal-COM, 94.76% of the hearing loss was of the conductive type and only 5.23% was mixed type, whereas in squamous-COM mixed hearing loss increased to 17.28%. Opposite to our findings, mixed hearing loss was seen more often in mucosal-COM by Kumari et al.<sup>34</sup> In general, a healed tympanic membrane is rarely considered a problem therefore hearing tests are only occasionally done, especially in children. In our study, we noticed that 17.22% of the total hearing loss was seen in children with healed tympanic membranes and 4.60% of which was of mixed type. This finding suggests that scarring of the tympanic membrane should not be taken casually, and it should be further investigated for hearing loss. Similarly, atelectasis of the tympanic membrane was also found to be associated with involvement of the inner ear.<sup>44, 46</sup> The size of the tympanic membrane perforation was also found to be related to sensorineural hearing loss.<sup>44, 46</sup> In this study, 75.68% of the children had large sized tympanic membrane perforations, but we did not observe similar findings. We did not find any cases of COM with profound hearing loss. This could be because children with profound hearing loss may be deprived of enrolling into the normal education system and were thus under-represented in our study.

Poor socioeconomic status has been associated with a higher prevalence of COM due to risk factors such as poor hygiene, overcrowded living conditions and malnutrition.<sup>9, 30</sup> This study was conducted in children studying in government schools. The schools run by the state government in Nepal are considered to provide inferior education quality as compared to the more expensive private schools. Therefore, only the most underprivileged children attend government schools. That could explain the higher prevalence rates seen in our study population. Many studies found statistically significant association between COM and socioeconomic status.<sup>11, 30, 47, 48</sup> In school-based studies, prevalence of COM was found more commonly in children studying at rural schools as compare to urban schools; 2.7% versus 0.7%,<sup>15</sup> 5.11% versus 2.32%,<sup>28</sup> 7% versus 1.8%,<sup>30</sup> and 5.7% versus 4.8%.<sup>48</sup> The wide variation was because these studies were conducted in areas where distinct differences in socioeconomic status such as low socioeconomic status in rural areas and higher status in urban schools was obvious. Lack of access to proper health care in rural settings is another reason for the wide variations in prevalence rates. Hence, improvement in access to

affordable health care for children of such communities could decrease the disease burden.

This study has both strengths as well as weaknesses. The strength of our study is that it is the largest study documented in a pediatric population in recent years in Nepal, and it explored the detail classification of chronic otitis media and hearing evaluation of all the children with COM. A limitation of this study is that this is a retrospective school-based study. This study only covered schoolchildren; younger children and those who did not attend schools were not included in the study. Although examinations were carried out using an otoscope in respective schools by senior Ear Nose and Throat surgeons with more than five years of experience, early cases of cholesteatoma could have been misdiagnosed as mucosal-COM. Microscopic examination of the ears of all the children was not feasible for the children in this study.

This study suggests that chronic otitis media is still a public health issue in Nepal that needs to be addressed urgently to reduce the burden of disease. Findings of our study could help in developing a national health care program focusing on ear and hearing care in Nepal. Measures such as conducting school entrance ear screening, raising public awareness about ear and hearing care, and early treatment of chronic otitis media could prevent hearing loss in most children.

## V. CONCLUSIONS

Chronic otitis media is a public health issue in Nepal. Early diagnosis and proper treatment of chronic otitis media could prevent most of the hearing loss in schoolchildren. Health measures such as school entrance screening, public awareness program and integration of ear and hearing screening in national health care could reduce the burden of disease.

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